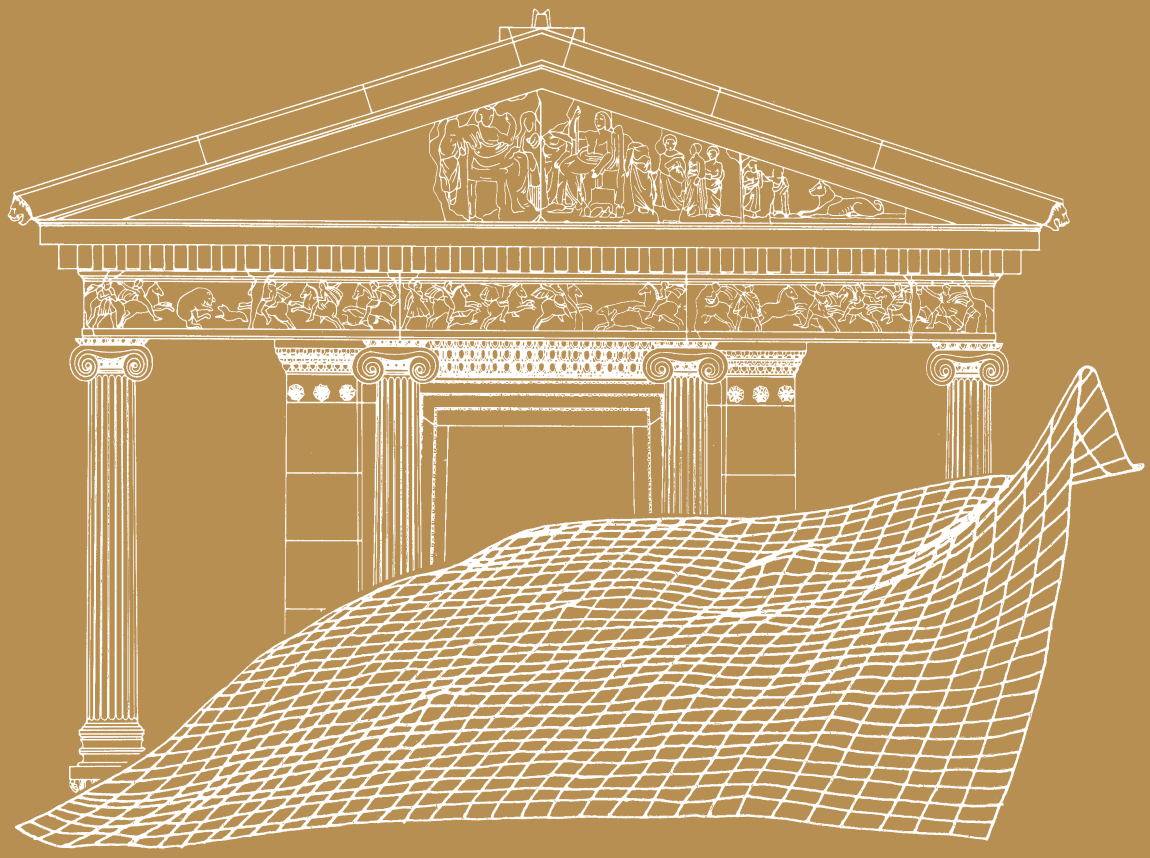

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MODELLING THE LANDSCAPE. FROM PREDICTION TO POSTDICTION. PROCEEDINGS OF THE INTERNATIONAL SESSION AT THE 7TH LANDSCAPE ARCHAEOLOGY CONFERENCE (IAȘI, 10-15 SEPTEMBER 2022)

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FROM LEGACY DATA TO SURVEY PLANNING? THE RELATIONSHIP BETWEEN LANDSCAPE AND WATERSCAPE IN SOUTHERN TUSCANY DURING THE UPPER PALAEOLITHIC: TOWARDS A PREDICITIVE-POSTDICTIVE APPROACH

1. Introduction

The present work focuses on the relationship between the prehistoric landscape and waterscape of Southern Tuscany (central Italy) during the Upper Palaeolithic – between 38.000-12.000 years BP – with the aim of analysing the peopling processes linked to the significant changes taking place in its coastal district. In order to address the biases implicit in this research objective, a postdictive approach was used with the goal of establishing a framework on which to develop future research. The irregularly progressive decrease in global temperatures, culminating with the Last Glacial Maximum (LGM) between 30.000 and 16.000 BP, produced the maximum global ice volume and lowest sea level, making way to vast new surfaces and land masses that emerged as sea levels dropped. The dramatic effects of these changes influenced the displacement of human populations and the establishment of various subsistence or settlement strategies. Today, much of this landmass has once again been submerged, a series of geomorphological transformations, which have also occurred inland, affecting the visibility and conservation of prehistoric traces in the archaeological record.

This paper presents the first stages of this predictive-postdictive analytical process (Arnoldus-Huyzendveld *et al*. 2016), with particular focus on data input build-up: namely the geomorphologic settings useful for understanding the main effects of landscape-waterscape changes, as well as the acquisition of legacy data, which in this case study constitute a key archaeological source.

2. Methodological approach

This currently ongoing research is centred on Southern Tuscany and the islands of the Tuscan Archipelago which provide a unique context for assessing changes in the local waterscape and how this affected the peopling processes during prehistory. Heterogeneous evidence attests to the presence of Upper Palaeolithic human communities in today's coastal areas, revealing the attractiveness of these contexts. Moreover, archaeological evidence recorded at the inland cave site of Grotta del Sambuco (Massa Marittima, Grosseto) suggest that during the Upper Palaeolithic, human groups living in the hinterland were willing to travel long distances in order to benefit from

the marine resources available in the coastal area (Pizziolo 2020, with references). While difficult to envisage daily treks, it is nevertheless possible to hypothesize that a "trip-to-the-seashore" may have been part of that form of subsistence mobility associated with inland communities.

How can we explore this landscape-waterscape relationship that influenced the lives of Palaeolithic groups? In order to increase our understanding of settlement dynamics and to address the relevant biases associated with these issues, a postdictive approach has been proposed with the aim of establishing a framework on which to develop future avenues of research. With these considerations in mind, it is worth setting up a GIS system to obtain landscape-waterscape surfaces related to LGM changes while integrating various archaeological proxy data so as to analyse, from a predictive-postdictive (Arnoldus -Huyzendveld *et al*. 2016) perspective, the prehistoric landscape. The final goal of the project will be to answer a series of questions posed by the postdictive approach, although in the current stage of the research it is first necessary to establish the prehistoric setting and reflect on the various biases associated with it.

3. The study area: a transect to test procedures

The research is centred on the Grosseto district, specifically on a geographical transect defined according to watercourses. The study area includes different land units, morphologies and waterscapes, providing a heterogeneous landscape useful for testing the aforementioned methodological approach and analytical procedures. Starting from the NW, the transect (Fig. 1) is bounded by the Cecina river, encompassing the southern portion of the district of the Colline Metallifere; towards the NE it reaches the junction between the Merse and Ombrone rivers, including to the S the territory as far as the Albegna river. The present-day landscape is generally hilly, with the exception of the northern sector where the mountainous reliefs form an important watershed between different catchment areas. In the southern part of the Grosseto district, during the Etruscan and Roman period, the Bruna and Ombrone rivers formed a wide alluvial plain occupied by the Prile lake. This water basin gradually developed into a swamp, until land reclamation activities, carried out until the 20th century, drained most of the wetlands. It should be noted that these recent activities deeply affected the possibility of reconstructing prehistoric contexts dating back to the Upper Palaeolithic, as they were covered by reclamation deposits.

Conversely, in the southern coastal area, the Monti dell'Uccellina and the promontory of the Argentario constitute two intact calcareous reliefs, morphological landmarks offering natural resources and cave shelters to prehistoric peoples. Moreover, as already mentioned, the coastal area was markedly different from how it appears today. We must remember that during the LGM (Lambeck *et al*. 2014), when the sea reached approximately -120 m below the

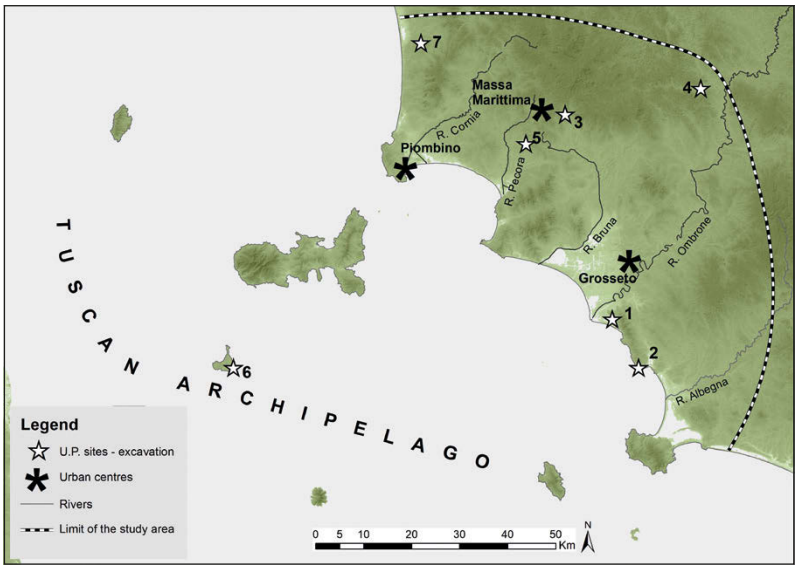

Fig. 1 – The study area. Upper Palaeolithic cave and open-air sites (stratigraphic evidence): 1) Grotta La Fabbrica; 2) Grotta Golino; 3) Grotta del Sambuco; 4) Petriolo; 5) Vado all'Arancio; 6) Grotta di Cala Giovanna; 7) Greppi Cupi (I and II).

current level, nearly all the islands of the Tuscan Archipelago formed a single land mass with the mainland. According to global reconstructions of sea-level changes (see as a general reference Benjamin *et al*. 2017), the waterscape-landscape relationship from 38.000 to 12.000 years BP was quite dynamic, entirely different from Holocene settings, and difficult to define at a local scale.

4. Upper Palaeolithic contexts: first level of data input

The stratigraphic evidence from the Upper Palaeolithic period documented in the study area is mainly related to cave sites excavated in recent decades. One of the most significant in the coastal area is Grotta La Fabbrica, located on the western slopes of the Monti dell'Uccellina and which has preserved an important prehistoric sequence attesting to the intensive use of the cavity (Dini, Tozzi 2012) during the Middle and Upper Palaeolithic (Mousterian, Uluzzian, Aurignacian, Gravettian - Epigravettian). In addition to this cave, other surface evidence related to Uluzzian and Aurignacian phases has been recorded in coastal (Monte Argentario, Freguglia 2008) and inland areas (Massa Marittima and Petriolo), also near jasper outcrops used as raw material (Galiberti 1970). On the southern side of the Monti dell'Uccellina, the site of Grotta di Golino shows the presence of a partially excavated and now lost

Gravettian layer, as work was carried out between the 19th and 20th century. On the contrary, the ongoing excavation at Grotta del Sambuco (Massa Marittima) reveals a stratigraphic sequence that attests to the long use of the karstic cavity: Gravettian (SU 6 – 23.632±150 BP), Epigravettian (SU 4 13.615±75 BP) and Holocene evidence (Neolithic and historical phases) (Calattini *et al.* 2015-17).

An increase in the number of archaeological sites is documented in the district of Grosseto during the Epigravettian, a trend in line with the rest of the peninsula, with caves, shelters and open-air contexts linked to dwellings or funerary activities. The Epigravettian evidence analysed throughout the stratigraphic sequence refers to the final Epigravettian, recorded at Grotta del Sambuco (SU 4) and at the shelter of Vado all'Arancio (Massa Marittima, 11.600±130 BP, Minellono 1980), the latter also revealing the presence of numerous engraved bone artefacts as well as two burials.

As for the landscape/waterscape relationship, the role of the Ombrone river must also be considered. Gravettian and Epigravettian evidence, in fact, is also attested at the site of Petriolo (Donahue, Chartkoff 1983), located at the confluence of the Farma and Ombrone rivers, an area rich in thermal springs. The analysis of lithic artefacts from the cave site of Grotta di Cala Giovanna (Grifoni Cremonesi 1971), located on the shoreline of the Island of Pianosa and excavated in the 19th century, suggests that the cave was inhabited during the initial phases of the Final Epigravettian. Along the coast, in the area of Donoratico, stratigraphic investigations in the Pleistocene sands documented two small temporary structures at Greppi Cupi I and II (Tozzi, Dini 2007), dating to the last phases of the Final Epigravettian. Greppi Cupi II, a sunken hut dwelling with artefact scatters, revealed the use of local raw materials collected from nearby riverbeds, whilst the faunal remains are referable to a woodland environment; the shelter feature at Greppi Cupi I, on the other hand, attests to the continuity of use of this site even in the transition phase to the Mesolithic.

5. The reconstruction of landscape changes: a first step

At this stage of the project it is necessary to set up a palaeogeographical framework in which to insert archaeological data pertaining to that period of dynamic landscape changes that occurred before and after LGM, in the interval 35-12 ka BP. In this regard, it is crucial to know when and how the coastal changes occurred, as well as in what form the Tuscan Archipelago was actually part of the peninsula. To indicate the general trend, we refer to Global Mean Sea Level curves (Lambeck *et al.* 2014; Benjamin *et al.* 2017) even though we are aware that values may differ at a regional or local scale of analysis. The current focus is on the general reconstruction of different scenarios, without taking into account local factors due to isostatic and tectonic activities (Vacchi *et al.* 2016), alongside erosion and deposition factors related to geomorphological

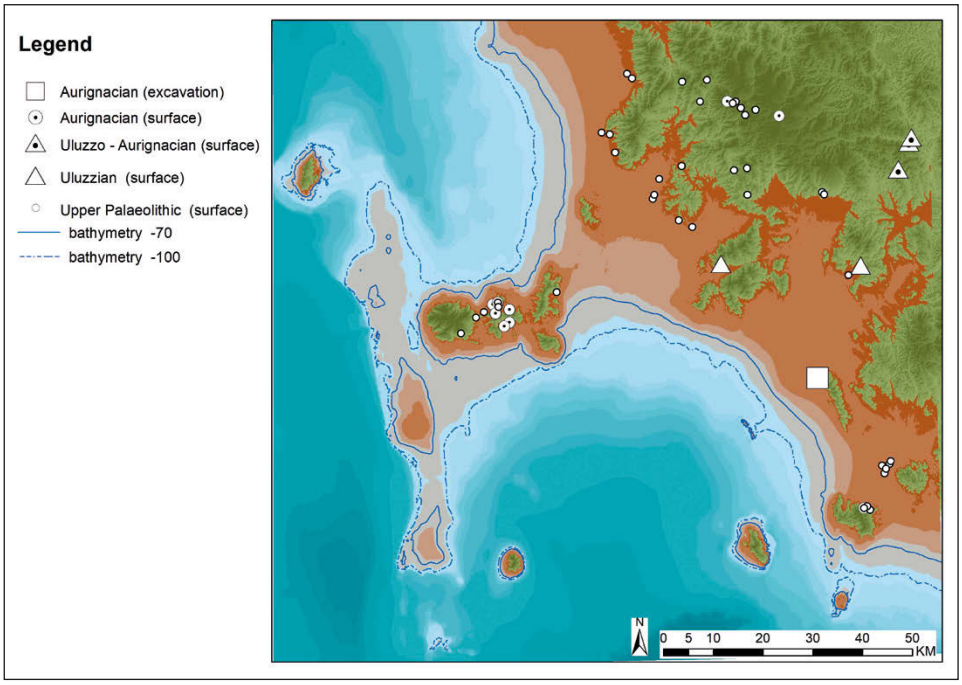

Fig. 2 – Landscape reconstruction of the case study transect during the Aurignacian. Marked in the legend are excavated sites and archaeological surface evidence.

changes. When the sea levels dropped, new land masses emerged and a new uninterrupted landscape was made available to human groups. Presently, our main goal is to obtain a general overall shape of that setting, calculated from the seabed surface of today. Available bathymetric data from EMODnet Digital Bathymetry (DTM 2020 - EMODnet Bathymetry Consortium - 2020), which offers a harmonised model generated from selected bathymetric survey datasets and Satellite Derive Bathymetry (SDB), were used to reconstruct this scenario.

The EMODnet DTM was logged into the GIS and combined with the detailed land DTM available from the Tuscan regional authority. The combination of these DTMs was used to establish different scenarios related to the main phases of the Upper Palaeolithic. Based on the sea level curves (Benjamin *et al*. 2017, fig. 4), the various palaeo-shorelines that characterised the landscape/waterscape dynamics in the past were plotted. Observing the different simulations, it is possible to note that during the Aurignacian (-70/-100 m below the present sea level), the islands of the Archipelago formed the promontories of a new gulf (Fig. 2); during the Gravettian (-100/-120 m) they became the headlands of a much narrower gulf (Fig. 3); whereas

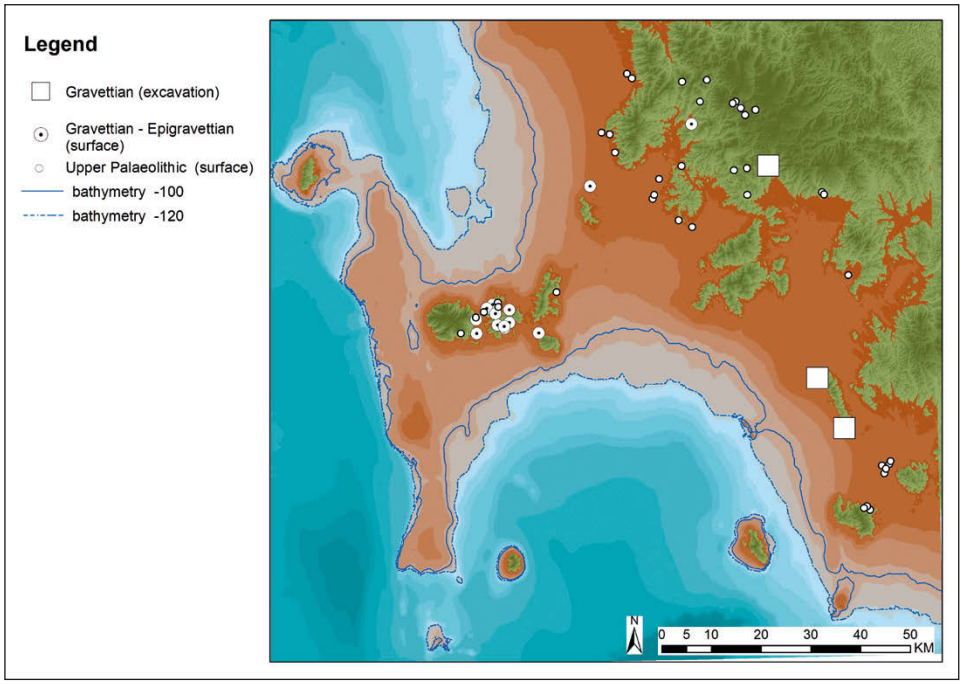

Fig. 3 – Landscape reconstruction of the case study transect during the Gravettian. Marked in the legend are excavated sites and archaeological surface evidence.

during the Epigravettian the sea level rose again (-85/-50 m), but the islands of Pianosa and Elba continued to remain connected to the mainland, respectively until the early and final phases of the period (Fig. 4). Furthermore, the use of EMODnet DTM enables to draw sections and profiles of the seabed's morphology, allowing to examine in detail the possible palaeo-connections between the present-day mainland and the nearby islands.

6. Legacy data and virtuous processes

In these new scenarios, the distribution of Upper Palaeolithic evidence (Fig. 1) appears as an uneven record of the peopling process and not so significant in the landscape/waterscape perspective. To improve the dataset, evidence from previous surface records was included, even at the risk of introducing generic information into the system. Since the 1960s, several non-systematic surveys have been carried out in the study area; sporadic finds were also recorded. Reports of these activities were published in an assortment of journals, bulletins and catalogues (as a reference: Pizziolo 2020 with references).

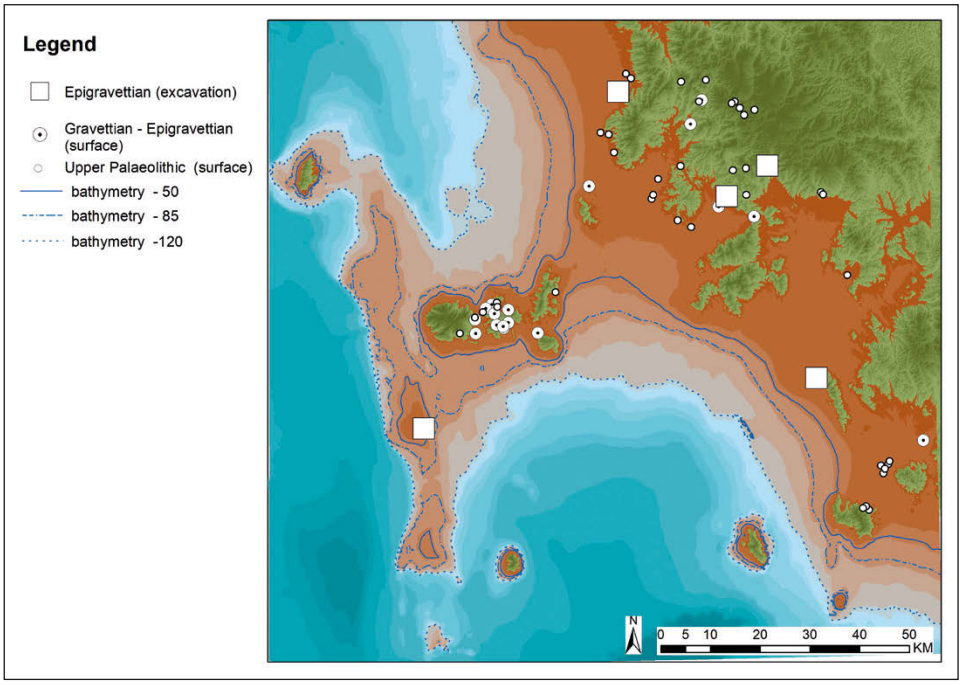

Fig. 4 – Landscape reconstruction of the case study transect during the Epigravettian. Marked in the legend are excavated sites and archaeological surface evidence.

In order to reduce bias, these legacy data were analysed and sorted in a DB according to the following criteria: depositional characteristics; quantity and quality of the finds; chronology; extent and accuracy of the location. Some surface records documented significant assemblages referable to single or double phases. Others are only generically attributable to the Palaeolithic. By managing this information through GIS it was possible to obtain a general assessment of its reliability and relevance.

Thus, legacy data, although less accurate, can be used as proxy data attesting to the spread of human groups across the territory (Figs. 2, 3, 4). The analysis of the geomorphological context of some stratigraphic evidence can provide new insights for the identification of topographical features and geological formations with archaeological potential (Pizziolo, Volante 2015 for similar analysis criteria). To implement this approach, geological maps at different scales were added into the system. The most effective elaborations were obtained by adopting the maps which provide details on coastal formations and a selection of Pleistocene deposits of the Tuscan regional authority at a scale of 1:10.000. In this case, the archaeological information

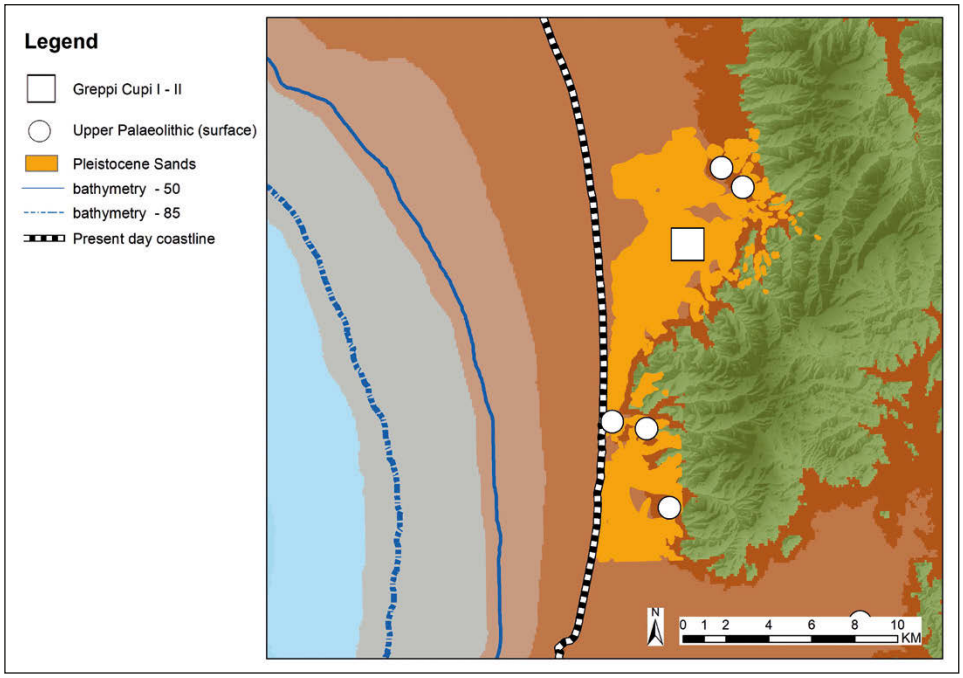

Fig. 5 – Greppi Cupi (Epigravettian): the relationship with the Pleistocene sands and other Palaeolithic evidence (from the Tuscan regional geological map 1:10.000).

of the Greppi Cupi sunken features, excavated in Pleistocene sands (*supra*), was included, defining the extent of these sandy deposits in the area (Fig. 5). This approach contributes towards a better understanding of settlement strategies, investigating why certain choices were made in relation to the general layout of the (present-day) coastal board, while simplifying the identification of relict features related to the prehistoric landscape.

In short, a sort of virtuous and circular process has been constructed: a) the distribution of sites or off-sites on the surface helps identify relict features of the prehistoric landscape and b) select morphological and sediment criteria to recognize them; then c) assess and predict potential areas for new investigations. It is interesting to note, from a predictive-postdictive perspective, that the Pleistocene sands around Greppi Cupi during the Epigravettian were not shoreline features but originally part of the upper coastal belt, possibly surrounded or in the vicinity of woodland, as testified by the faunal remains recorded from the site (*supra*). The distribution of Palaeolithic surface evidence on the Pleistocene sands of Donoratico offers new hints in planning further investigations in that area.

7. Conclusive remarks

The critical acquisition of archaeological legacy data has provided an important support to our predictive-postdictive approach. Once evidence obtained from surface collections as well as bathymetric and geomorphological data were added into the GIS, it was possible to explore different prehistoric landscape scenarios. Moreover, it is possible to return to some of our initial questions, suggested by the analysis of Grotta del Sambuco, focusing on Upper Palaeolithic settlement strategies and their involvement in waterscape and marine resources. Observing the different Upper Palaeolithic reconstructions, one can note that a series of possible activities (dwellings, artefact production, hunting, raw material procurement) are spread in the form of sites or off-sites, providing newfound insights in the reading of hills, coastland and archipelago land units. The Island of Elba attracted Aurignacian groups, but in particular Gravettian-Epigravettian communities, consolidating our idea of attraction/interest in the paleo gulf as already witnessed by the cave of Cala Giovanna at Pianosa (*supra*).

The upper coastal belt and the inner valleys have revealed evidence as to the presence of circulating human groups, suggesting new hypothesis on possible "trip-to-the-seashore" behaviours and relative traces. Nevertheless, further analyses of geological maps along with the assessment of erosion/deposition factors, must be carried out before attempting a postdictive cost surface (Citter, Patacchini 2018) in order to build a postdictive least cost path. The study is still in progress.

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ABSTRACT

During the Upper Palaeolithic, Southern Tuscany was strongly affected by geomorphological changes that significantly altered its coastal seaboard. In particular, during the Last Glacial Maximum, the sea reached a level below 100 meters. As a result of this, the prehistoric coastland included also the present Tuscan Archipelago, in particular the Islands of Elba and Pianosa, assuming a different layout during Marine Isotope Stage (MIS) 3 and 2. In this context, the process of prehistoric occupation took place, according to different needs and criteria. The present work explores the possibility of investigating the dynamic relationship between the prehistoric landscape and waterscape by a predictive-postdictive approach. Alongside the simulation of coastal changes, the study makes use of legacy data, taking into account those derived from artefact surface scatters collected over the past decades by various research groups. The latter provide further evidence of the prehistoric occupation process. In this scenario it is crucial to highlight areas that potentially still retain some relict features of the Palaeolithic landscape. These are examined in order to better understand settlement strategies taking place during the Upper Palaeolithic and, at the same time, to investigate the relationship between inland and coastal sites in a diachronic perspective. Although still ongoing, preliminary results provide new elements for the planning of future field surveys.

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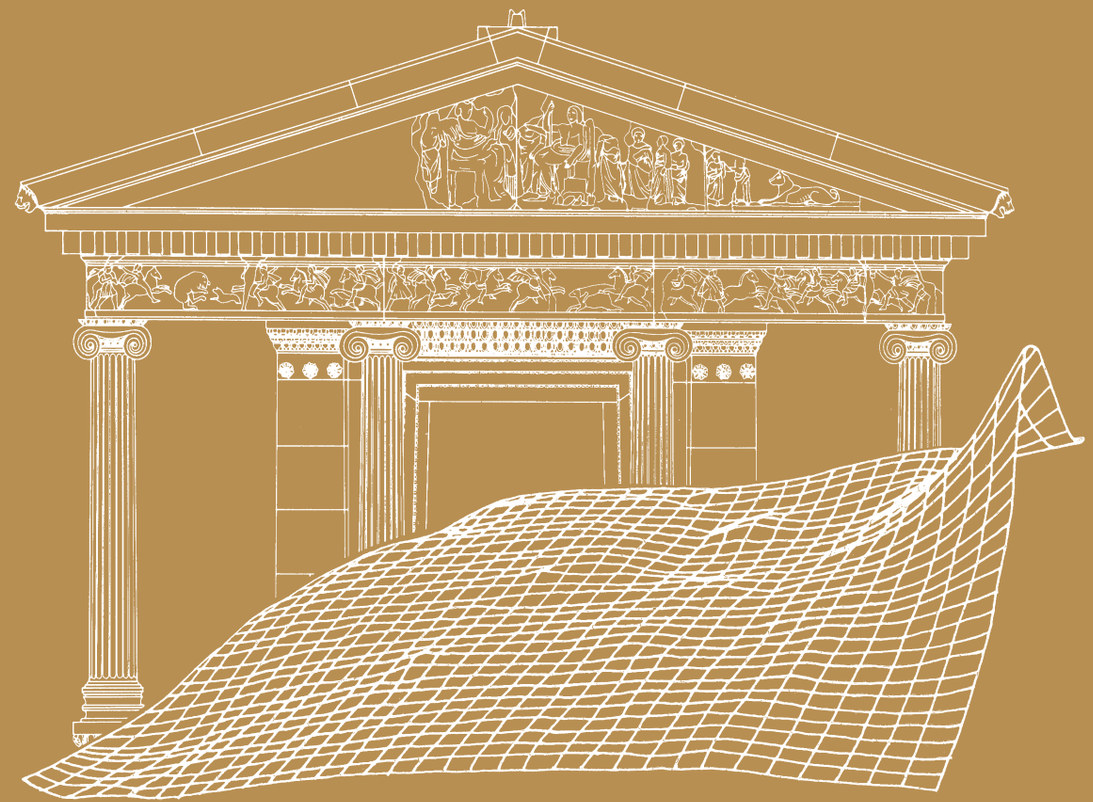

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